

Higher education at the intersection: Open source software and open educational resources

Abstract

Institutions of higher education are facing increasing competition for scarce financial resources. At the same time these academic centers must maintain and distinguish those unique qualities that make their institution most attractive to students. Colleges and universities are increasingly aware of the necessity to use technology to meet both the business and academic mission of the institution. Technology provides an open door to create an educational setting that is cost effective, efficient, and promotes a learning environment that will prepare students to be productive citizens and workers in the twenty-first century. Often, open source software (OSS) and open educational resources (OER) are seen as viable options for meeting these challenges. Many campuses are recognizing the importance of the interplay or overlap between OER and OSS as an important feature for providing high quality teaching and educational experiences.

What is OSS?

Many terms relating to technology have more than one acceptable definition or sets of defining criteria and OSS is no exception. In his groundbreaking book *The Cathedral and the Bazaar*, Eric Raymond (2000) provided an important framework for developing OSS, focusing attention on project development by a decentralized community of users and developers providing frequent peer review to create high quality and less expensive software. Additionally, both users and developers of OSS often rely on the guiding principles put forth by the Open Source Initiative and the Free Software Foundation as they undertake open source projects.

The Open Source Initiative (OSI) specifies ten criteria that must be met for software development projects to be considered open source. The criteria cover the development of source code and its modification, licensing, and distribution. In brief, the OSI definition specifies that anyone can have access to the source code, that anyone can modify the source code, that the license must not inhibit distribution of the source code or its derivatives in any way (even commercially), that OSS may be used in combination with other software products, and that there cannot be discrimination against persons or projects using or implementing OSS for any purpose.

The Free Software Foundation provides a more succinct definition by outlining “four essential freedoms” as follows:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and change it to make it do what you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to improve the program, and release your improvements (and modified versions in general) to the public, so that the whole community benefits (freedom 3). Access to the source code is a precondition for this.

According to the Free Software Foundation, all four criteria must be met for software to be considered open source.

What are OER?

Like open source software, open educational resources are often defined in several ways. It is widely recognized that the term open educational resource was coined by UNESCO in 2002 as it sought a definition for educational content that could be made available through the Web. UNESCO clearly saw the power of the Web to deliver educational materials throughout the world and especially to under-resourced countries. The definition of OER as stated by UNESCO is as follows, “the open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for non-commercial purposes.”

The report *Giving Knowledge for Free* (2007) published by the Organization for Economic Cooperation and Development (OECD) provided the following “commonly used” definition of OER as: “digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research” (p.10). However, a report published by the Open eLearning Content Observatory Services (OLCOS) called *Open Educational Practices and Resources: OLCOS Roadmap 2012* (2007) acknowledged that no “authoritative” definition has emerged (p. 20). The OLCOS Roadmap 2012 instead focuses on three central criteria of OER that must be present to promote instructional practices that will best aide students in facing the challenges of a knowledge society including:

- providing free access to content and its metadata so that these resources are findable and useful in formal settings to teachers and students and informally to lifelong learners,
- licensing educational materials so that they remain available for re-use and re-mixing with other materials as needed, and

- using OSS so that the source code for educational tools remains available to be re-used and modified (p. 20).

Despite these definitions it might still be difficult to understand the exact content of an OER. Here again, both *Giving Knowledge for Free* and the OLCOS Roadmap 2012 provide valuable guidance. Each of these reports provides three distinct categories of OER:

1. course or educational content such as a class syllabus, a lecture, or a learning module
2. software for a tool such as a learning management system, blog, or wiki, and
3. implementation tools such as a license that specifies how the OER may be used or modified by others.

One of the interesting aspects of the definitions provided above is the emerging importance of the relationship between OSS and OER.

What is a knowledge society and what role do OER and OSS play in the knowledge society?

The terms knowledge worker and knowledge society were both used by Peter Drucker, one of the premier thinkers about business management. Institutions that value knowledge workers understand that the worker has a better understanding of his role and responsibility than any manager. The knowledge worker, appreciated for the skills brought to the position, is well able to self-manage all the tasks associated with successful completion of her job. In an article written for the *Atlantic Monthly*, Drucker (1994) expressed his belief that the knowledge worker would become the predominant member of the workforce in the knowledge society. Drucker (1994) provides a brief description of the education and training that will be necessary in the knowledge society:

“Education will become the center of the knowledge society, and the school its key institution. What knowledge must everybody have? What is “quality” in learning and teaching? These will of necessity become central concerns of the knowledge society, and central political issues... In the knowledge society, clearly, more and more knowledge, and especially advanced knowledge, will be acquired well past the age of formal schooling and increasingly, perhaps, through educational processes that do not center on the traditional school.”

Although Drucker's formulations of the knowledge society seem highly prescient, it does not seem possible that anyone could have predicted the transformation brought about by the Internet.

A growing body of literature addresses the changes and challenges that face both higher education and society as a result of the advent of the Internet and the Web. *Towards Knowledge Societies*, a UNESCO World Report published in 2005, provides an updated conceptual understanding:

“Knowledge societies are about capabilities to identify, produce, process, transform, disseminate and use information to build and apply knowledge for human development. They require an empowering social vision that encompasses plurality, inclusion, solidarity and participation” (p. 26).

UNESCO (2005) makes two important distinctions as it considers knowledge societies. The first has to do with both “plurality” and “inclusion” as mentioned above as the report seeks to emphasize that there is no value judgment placed on knowledge—indigenous knowledge and formal education are equally respected. The second distinction is also part of the above definition. The report seeks to make very clear that information is not knowledge; rather knowledge is produced by what is done with the information and how it is interpreted. The latter is an important distinction between the knowledge society and the information society which has expanded rapidly in the online environment.

The OLCOS Roadmap 2012 also devoted considerable attention to new challenges to the knowledge society, focusing on education across the lifespan beginning with elementary school and continuing through to higher education and beyond. One of the strongest points made by the report is that the focus of higher education should be on using OER first and foremost to promote the skills needed in the current knowledge society through a “transformation in educational practices” (p. 37). Pedagogy must focus on “innovative approaches that foster self-management, communication and team skills, and analytical, conceptual, creative, and problem solving skills” (39). Although the method for educating students in these areas is somewhat undefined, the end result is not very different from the knowledge worker described by Drucker. However, as the OLCOS Roadmap 2012 describes the competencies needed by students it is clear that the times have changed. Students, future knowledge workers, must demonstrate that they are grounded in the twenty-first century through their ability to systematically access and organize relevant digital data and information that can be used creatively to solve problems, to clearly organize and present data in graphical and other formats showing an ability to translate complex information, to use Websites and other electronic resources effectively to gain objective information, and to gain ICT skills that foster “creativity and innovation...at home, leisure, and work” (p. 39).

Web 2.0 technologies such as blogs and wikis are one way that both teachers and students can meet these demands. The beauty of these two technologies in particular is that they are readily accessible through OSS options and require minimal training and practice for both teachers and students to use successfully. As OER tools, both blogs and wikis meet many of the criteria outlined in the discussion above. Teachers can set parameters for use that help students achieve course goals, providing both focus and guidance. Wikis and blogs present perfect forums for self-guided student learning and opportunities to demonstrate their ability to gather, organize, analyze and present information. Both technologies can be used to explore problems and provide avenues for discussion and feedback from a community, using developing ICT skills. The wiki presents a more robust format for collaborative efforts for designing and developing course projects due to its reliance on the community to make regular contributions and provide relevant feedback.

Although their rationale and approach are somewhat different, Seeley and Adler (2008) clearly see the benefits of Web 2.0 technologies in the classroom to fulfill many of the same needs of the knowledge worker in the knowledge society. The authors place more emphasis on Web 2.0's power to blur the lines between producer and consumer for example by providing students with opportunities to conduct real-time research with scientists from around the world. Additionally, Seeley and Adler (2008) see a shift from the focus on information access to accessing people, providing myriad paths for social learning (p. 18).

“Social learning is based on the premise that our understanding of content is socially constructed through conversations about that content and through grounded interactions, especially with others, around problems or actions... the social view of learning says, ‘We participate, therefore we are’” (p. 18).

As Seeley and Brown (2008) further explore social learning, they highlight the concept of “learning to be.” Students need to do more than learn about a subject, they need to become part of a community of practice through active engagement. The development of OSS provides a strong example of a community of practice in which a group establishes how it will function to meet project goals. New participants must transition into the community by learning how it functions as they make contributions to the group effort. Seeley and Brown (2008) believe that all students must learn to be a “full participant in the field [by] acquiring the practices and norms of established practitioners in that field or acculturating into a community of practice” (p. 19). Seeley and Brown (2008) provide a useful review of Web 2.0 technologies from wikis to virtual worlds providing innovative forums for teaching and learning.

Are there examples of other educational tools at the crossroads between OER and OSS that give students the opportunity to develop these skills?

There are a growing number of software tools that are dramatically increasing the breadth and depth of OER for teaching and learning. For example, the University of California, Berkeley created a 3D virtual environment of an actual archaeological dig in Turkey. The Website called Remixing Catalhoyuk (<http://okapi.dreamhosters.com/remixing/mainpage.html>) provides an interactive experience that uses videos, maps, timelines, music, and still shots that exemplify the practice of archaeology. Students and teachers are invited to download, share, remix, and republish any of the materials found on the Website. All of the tools used to develop the Website are open source. The Science Museum of Minnesota's Learning Technologies Center hosts the Open 3D Visualization Toolkit at <http://ltc.smm.org/visualize/about>. The project is a strong example of an opportunity for students to actively engage in a community of practice and social learning.

Visual Understanding Environment (VUE) is an OSS tool that allows individuals and groups to generate concept maps. Developed at Tufts University, the Website (<http://vue.tufts.edu/>) describes VUE as a flexible tool “for managing and integrating digital resources in support of teaching, learning and research.” VUE allows both individuals and groups to find new ways to organize information and create new meaning through the formation of unique concept maps. Kahle (2008) emphasizes the careful design criteria that enabled the development of VUE, paying close attention to the “adaptable design principles” that make VUE useful for collaborations as well as individuals. Concept maps can be used to provide a visual explanation of a body of knowledge, to link digital content for contrast and comparison and provide new meaning, or to generate a visual understanding of an organization or project. In addition, view gives the project participants the tools they need to organize content directly from the concept map for a slide presentation. VUE provides a way for teachers to guide students towards an existing community of practice or to develop a new one, to develop ICT skills, and to develop concept maps collaboratively as a social learning experience.

The KEEP Toolkit has been used by teachers to provide a visual record or online portfolio of their teaching experiences and practice. Iiyoshi and Richardson (2008) report that between 2004 when the Keep Toolkit became publicly available and 2007, over 30,000 students and educators worldwide have produced over 100,000 “online representations and collections” (p. 348). The site is designed so that no Web development is necessary to generate an attractive ePortfolio that includes text, images, or links to resources. The KEEP Toolkit has also been used to create student ePortfolios that display their accomplishments. Again, the ease with which a student can achieve success makes this OER very user friendly. Developed by the Knowledge Media Lab of the Carnegie Foundation, the KEEP Toolkit can be downloaded from SourceForge or it can be used as online. A prominent goal of the KEEP Toolkit was developing a strong community of practice amongst teachers and a means for

enhancing pedagogy. The Carnegie Foundation hosted the KEEP Toolkit through its development, release, and early years of use. Recently the KEEP Toolkit transitioned to the Merlot site. Information about the KEEP Toolkit and its move can still be found at < <http://www.cfkeep.org/static/index.html>>.

How are teachers responding to OER and OSS as tools for changing pedagogy?

Research on the impact of new tools on teachers and/or their practice is emerging. Harley (2007) designed and conducted a survey of humanities and social sciences professors to get a better understanding of use of educational technology environments, the users, and the barriers for nonusers. The survey was delivered to 4,443 faculty and 831 valid responses were received. The survey, which does not ask the scholars to rate an educational resource, seems to provide genuine feedback about the scholars because they were asked about themselves. The survey found that there was a range of faculty use of technology resources including the nonuser—many of whom were “passionately opposed”—to the avid user of these resources. Some faculty reported that they were novice beginners while others were clearly experts. Perhaps most importantly as seen from the two groups at either end of the spectrum teaching philosophy and style greatly influenced the use of technology resources. A second key finding was that faculty in different disciplines make use of different resources and those teachers who have built personal collections of teaching materials are reluctant to give them up. A real take home message is that developers of OER/OSS tools need to be very careful about assuming that all humanities teachers share the same guiding principles. Finally faculty non-users site very real issues such as an inability to access the resources, lack of funds to purchase classroom equipment to support resource use, and sheer lack of time to find and learn uses for these resources.

Little, et.al. (2009) provides a description of the “Top Ten Teaching and Learning Challenges of 2009. Through the use of open source tools such as a wiki Educause, in effect, created a think tank to look at the issues most worrisome to academics and administrators. Challenge number four on the list was “encouraging faculty adoption and innovation in teaching and learning with IT” (p. 34). One commenter remarked, “Keeping faculty one step ahead of emerging technologies—and providing them with the support to manage what often feels like a rising tide of new tools and learning resources—can indeed be difficult. Managing the widening gulf between early adopters and less technologically savvy faculty can be downright frustrating. And then there’s the delicate balance between promoting technology tools and encouraging teaching and learning with technology” (p. 34). These comments are an anecdotal reflection of the findings in the survey described above.

Although these descriptions paint a less than rosy picture of the potential uses of OER/OSS resources there are anecdotal stories of successes as well. Calogne (2008) provides a detailed description of her use of virtual worlds as a teaching tool both in and

outside of the classroom. She provides guidance about how to structure individual sessions, the roles of the teachers and the students, and the overall use of the virtual world as a classroom resource. Calogne (2008) concludes with a case study describing her experience as well as the reactions of the students. Although Calogne (2008) focuses on the use of Second Life her advice and the lessons learned are transferable. Little, et.al. (2009) also describes a digital history project designed and implemented by students as part of a history seminar. Students and teachers learn together to manage problems. The authors particularly emphasize that the students become part of a history community of practice that recognizes the use of new tools for experimentation (p. 38).

Finally, Taylor and McQuiggan (2008) developed and implemented a survey of 221 faculty which focused on the actual needs of faculty for successful online teaching. The authors provide a very thorough review of the literature and the development of similar survey tools. Their findings indicate that for faculty there is a real disparity between training that teaches one how to use a given tool and instructional design that best uses these tools. Clearly these findings are in accordance with the comments made in the article by Little, et.al. (2009) bringing the discussion full circle.

What are some of the next steps for OER and OSS in higher education?

One of the most important current and ongoing developments for OER and OSS is their recognition as valuable components of cyberinfrastructure, particularly in connection with digital humanities scholarship and eHumanities. Seeley and Adler (2008) see OER as a key “building block” in a stack that also includes eScience, eHumanities, and Web 2.0 tools feeding into an “open participatory learning ecosystem” (p. 30). In their discussion of cyberinfrastructure for the humanities, Green and Roy (2008) recognize that these same puzzle pieces must fit together, requiring the close coordination of a number of professionals from varied fields including: “software programmers, designers, project managers, digitization specialists, copyright lawyers,” and others (p. 42).

There is no one formulation about the best way to bring all of these professionals together to develop these resources. But, there is awareness of community source software as a potential solution. Courant and Griffiths (2006) distinguish between “the open characteristics of open source software...and the manner in which it is produced. We refer to the community-based volunteer model associated with the likes of Linux and Apache as ‘community development,’ and note that it is also possible to produce software with open source code through a centrally managed (and often funded) process which we refer to as directed development” (p. 4)” Courant and Griffiths (2006) go on to describe the process for coordinating the development of software amongst colleges and universities with similar needs to create more efficient administrative functions particularly around billing, budgeting, and admissions. It is

easy to extrapolate from the community source or directed development model to meet eHumanities needs.

Freidlander (2009) is primarily focused on the needs of the eHumanities community for accessible digitized materials and their preservation. Although she does not explicitly mention the production of open source software through directed development she does clearly see the need for ongoing collaboration. Freidlander (2009) particularly recognizes the importance of such efforts as the Bamboo Project which was funded by the Mellon Foundation in early 2008. According to the Website the Bamboo Project (<http://projectbamboo.org/>) is “mapping out the scholarly practices and common technology challenges across and among disciplines to discover where a coordinated, cross-disciplinary development effort can best foster academic innovation.” The Bamboo Project has developed demonstrator projects one of which is The Software Environment for the Advancement of Scholarly Research (SEASR). The SEASR Website (<http://seasr.org/>) explains that the project was also funded by the Mellon Foundation and “provides a research and development environment capable of powering leading-edge digital humanities initiatives.” The SEASR platform includes OSS such as Zotero, VUE, and a program called MONK which analyzes text patterns.

Predicting the future of these OSS and OER efforts or of a single institution or of higher education generally is a difficult proposition. For higher education leaders it seems nearly impossible to know which tools and technologies will become popular enough to have a long-term future and which will signify the next wave. Alexander (2009) provides a range of forecasting models that can be used by higher education. While not without some risk as to its accuracy, forecasting can definitely spark a planning meeting.

Reference List

- Alexander, B. (2009). Apprehending the future: Emerging technologies, from science fiction to campus reality. *Educause Review*, 44 (3). Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume44/ApprehendingtheFutureEmergingT/171774>
- Brown, J.S. & Adler, R.P. (2008). Minds on fire: Open education, the long tail, and learning 2.0. *Educause Review*, 43 (1). Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume43/MindsonFireOpenEducationtheLon/162420>
- Calogne, C.M. (2008). Educational frontiers: Learning in a virtual world. *Educause Review*, 43 (5). Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume43/EducationalFrontiersLearningin/163163>
- Catalhoyuk Research Project. (n.d.). Retrieved from <http://okapi.dreamhosters.com/remixing/mainpage.html>
- Courant, P.N. and Griffiths, R.J. (2006). *Software and collaboration in higher education: A study of open source software*. Retrieved from http://www.e-learningcentre.co.uk/eclipse/Resources/OOSS_Report_FINAL.pdf
- Drucker, P.F. (1994). The age of social transformation. *The Atlantic Monthly*, 274 (5). Retrieved from <http://www.theatlantic.com/politics/ecbig/soctrans.htm>
- Free Software Foundation. (1985). *The free software definition*. Retrieved from <http://www.gnu.org/philosophy/free-sw.html>
- Friedlander, A. (2009). Asking questions and building a research agenda for digital scholarship. In Working together or apart: Promoting the next generation of digital scholarship (Chapter 1). Retrieved from <http://www.clir.org/pubs/reports/pub145/pub145.pdf>
- Geser, G. (Ed.). (2007). *Open educational practices and resources: OLCOS roadmap 2012*. Open eLearning Content Observatory Services. Retrieved from http://www.olcos.org/cms/upload/docs/olcos_roadmap.pdf
- Harley, D. (2007). Use and users of digital resources. *Educause Quarterly*, 30 (4). Retrieved from <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolume/UseandUsersofDigitalResources/162267>

- Iiyoshi, T. & Richardson, C.R. (2008). In T. Iiyoshi & M.S.V. Kumar (Eds.), *Opening up education: The collective advancement of education through open technology, open content, and open knowledge* (337-356). Cambridge, MA: MIT Press.
- Kahle, D. (2008). Designing Open Educational Technology. In T. Iiyoshi & M.S.V. Kumar (Eds.), *Opening up education: The collective advancement of education through open technology, open content, and open knowledge* (27-45). Cambridge, MA: MIT Press.
- Knowledge Media Laboratory of the Carnegie Foundation (2002). *KEEP Toolkit*
Retrieved from <http://www.cfkeep.org/static/index.html>
- Little, J.K., Page, C., Betts, K., Boone, S., Faverty, P., Joosten, T., ...Schwartz, C.M. (2009). Charting the course and tapping the community: The Educause top ten teaching and learning challenges 2009. *Educause Review*, 44 (3). Retrieved from <http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume44/ChartingtheCourseandTappingthe/171775>
- Open Source Initiative. (1998). *Open source definition*. Retrieved from <http://opensource.org/docs/osd>
- Organisation for Economic Development and Co-operation. (2007). *Giving knowledge for free: The emergence of open educational resources*.
<http://browse.oecdbookshop.org/oecd/pdfs/browseit/9607041E.PDF>
- Project Bamboo. (2008). http://projectbamboo.org/files/docs/bamboo_proposal.pdf
- Raymond, E. (2000). *The cathedral and the bazaar*. Retrieved from <http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/>
- SEASR. (n.d.). Retrieved from <http://seasr.org/>
- Taylor, A. & McQuiggan, C. (2008). Faculty development Programming: If we build it, will they come? *Educause Quarterly*, 31 (3). Retrieved from <http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolume/FacultyDevelopmentProgramming/163099>
- UNESCO. (2002). *Forum on the impact of open courseware for higher education in developing countries: Final report*. Retrieved from <http://unesdoc.unesco.org/images/0012/001285/128515e.pdf>
- UNESCO. (2005). *Towards knowledge societies: A UNESCO world report*. Retrieved from <http://unesdoc.unesco.org/images/0014/001418/141843e.pdf>

Visual Understanding Environment. (n.d.). Retrieved from <http://vue.tufts.edu/>